Collaboration Conducted by Intentional Declarations

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Overview

- Collaborating with associates
- Establishing task context
- Task context as a mediating interface

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Collaborating with Associates

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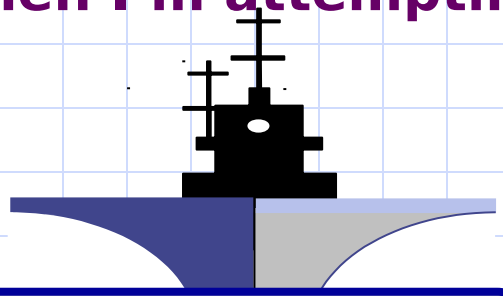
The “Associate Relationship”

Pilot Anecdote:

‘Can’t you make my cockpit smart enough not to flash a Low O_2 light in my face when I’m attempting a carrier landing at night??!!!’



One Pilot’s Definition

“You mean you’re going to put a system in the aircraft to help the pilot with all those other systems which were put in to help the pilot”

Drone/ Slave — **Assistant** — **Associate** — **Coach/ Supervisor**

The Big Tradeoff

Every-gets done <u>my</u> way

1. Pilot in charge of tasks
2. All needed tasks accomplished
3. Pilot in charge of information presented
4. All needed information provided
5. Stable task allocation
6. Only needed information provided
7. Tasks allocated as expected
8. Information presented as expected
9. Stable information configuration
10. Tasks allocated comprehensibly
11. Only needed tasks active

Every-thing gets <u>done</u>

Operators want to remain 'in charge', even when they can't be fully in control

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“Associates” for …

Pilot’s Associate

Rotorcraft Pilot’s Associate

Abnormal Situation Management

Driver Adaptive Warning System

Agile Information Control Environment

Building UI Generation

Playbook UIs

Independent LifeStyle Assistant

Rotorcraft Pilot's Associate

- Goal: Provide Adaptive Information and Automation management for advanced Rotorcraft with effectiveness and workload payoffs
- 5 year, $80M U.S. Army program
  - 1994-1999
  - Flight tested in 1999
- Honeywell team responsible for Cockpit Information Manager design

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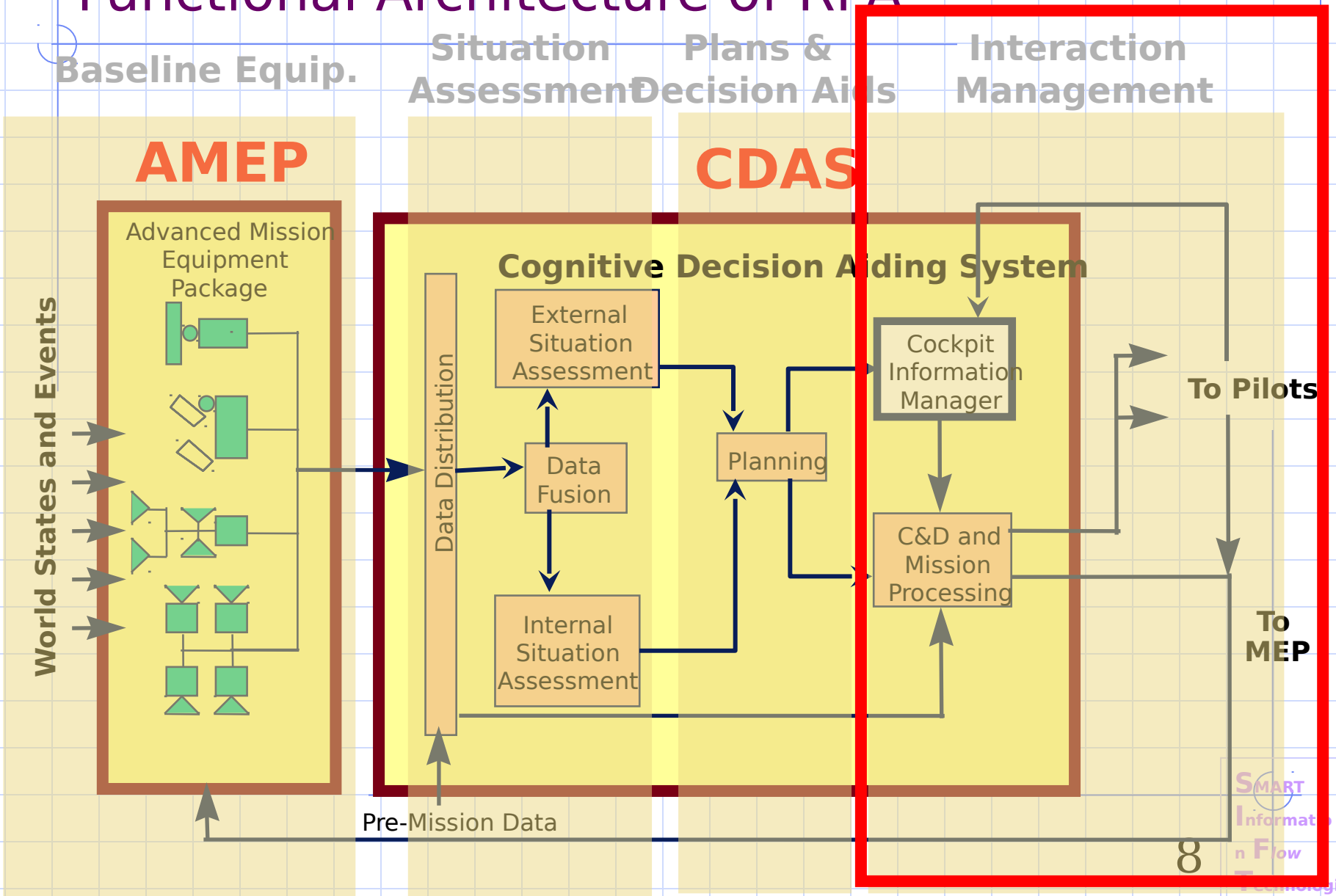
Functional Architecture of RPA

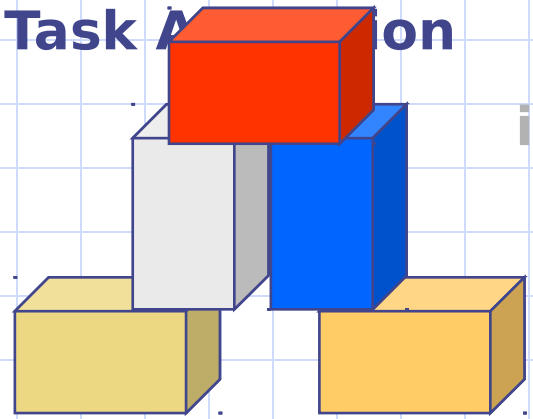


Cockpit Information Manager Behaviors

CIM accomplishes its goals of context sensitive task and information management through five observable behaviors:

1. **Page or Format selection**
2. **Symbol selection/ declutter**
3. **Window placement**
4. **Automated Pan and Zoom**
5. **Task A[illegible]ion**

They combine in multiple variations . . .



to provide intelligent cockpit information management. . .

in multiple contexts.

The behaviors are building blocks.

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RPA Window Placement Example

Default/Preferred Window Placement

Alternate, Scripted Window Placement

Window Placement for Actions on Contact given Threat Positions

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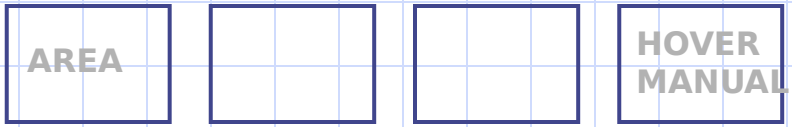
Crew Coordination & Task Awareness Display



MISSION **PILOT** **ASSOCIATE** **COPILOT**

- Four buttons to convey major, associate-inferred task contexts
- Single press overrides = “No, you’re wrong. That’s not what we’re doing”
  - Associate ‘gets out of the way’
- Press and Hold scrolls through tasks at same level of hierarchy
  - E.g., Area Recon, Zone Recon, Attack in Force, Hasty Attack, Delay, Evade, Ingress, Egress, etc.

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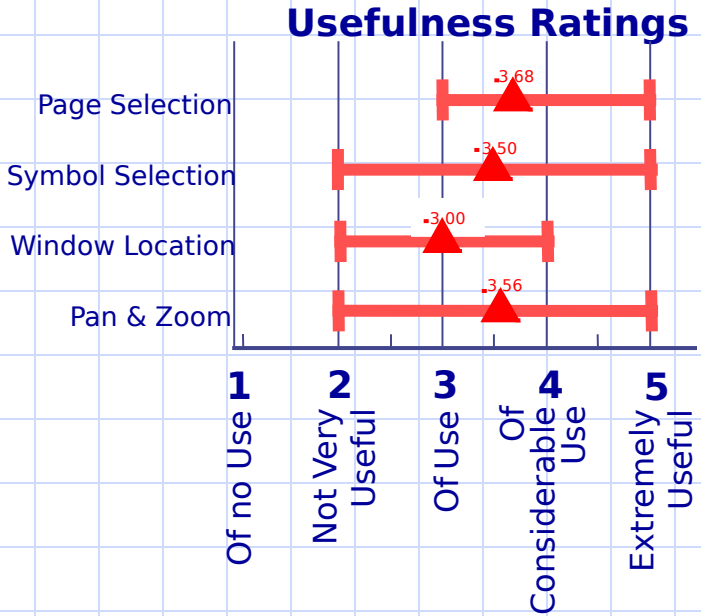
Subjective Workload (TLX) Ratings

TLXsubscale	Base mean	RPA mean	F-Value (df: 1,6)
Mental Demand	61.77	46.25	10.487*
Physical Demand	54.48	40.31	12.042*
Temporal Demand	62.08	45.73	14.061**
Perceived Performance	35.00	42.08	2.429
Effort	62.60	48.54	20.470**
Frustration	52.81	45.63	4.961

*p<.05 ** p<.01

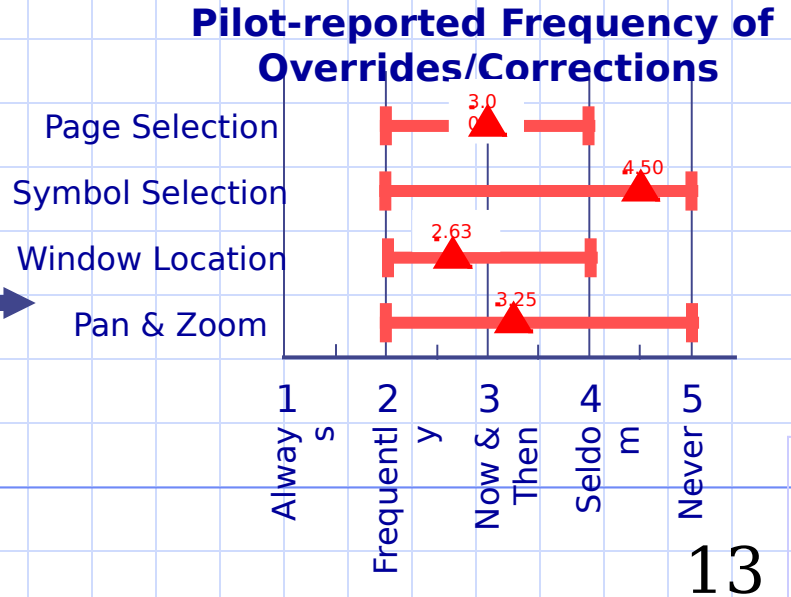
- Workload levels consistently higher for Baseline than for RPA
- Significant differences for 4 of 6 TLX subscales (and close for the 5th)
- No effect on Perceived Performance-- perhaps pilots factor technology effects into their expectations?

CIM Utility and Overrides



Most crews said CIM behaviors were ‘Of Use’ or “Of Considerable Use’

Crews ‘Seldom’ overrode CIM’s symbol selections, but ‘Now & Then’ overrode other behaviors



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Right and Wrong?

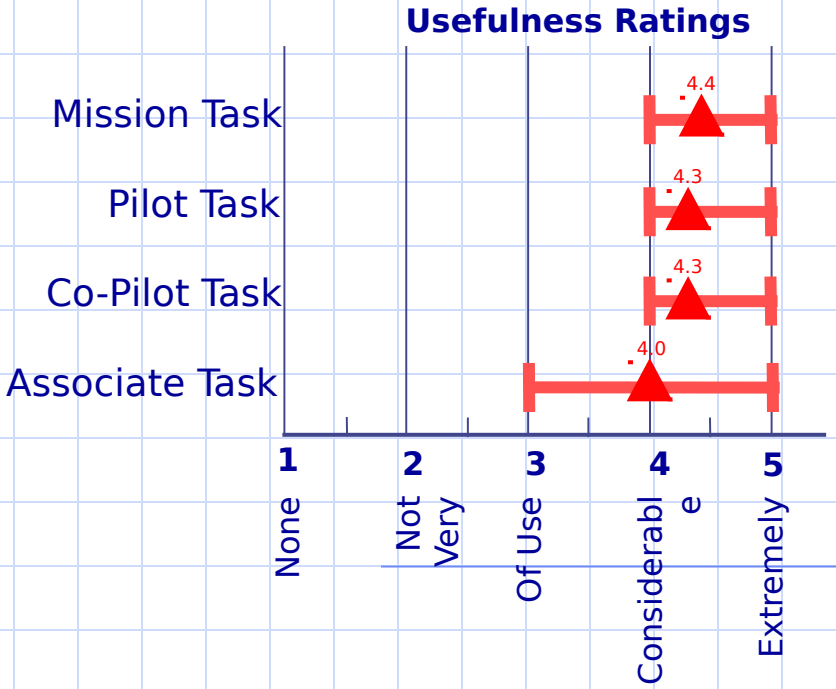
CIM was seen as useful and provided perceived performance and workload advantages

in spite of

‘Now and Then’ or ‘Frequently’ providing the wrong information.

Why?

Crew Coordination & Task Awareness Display

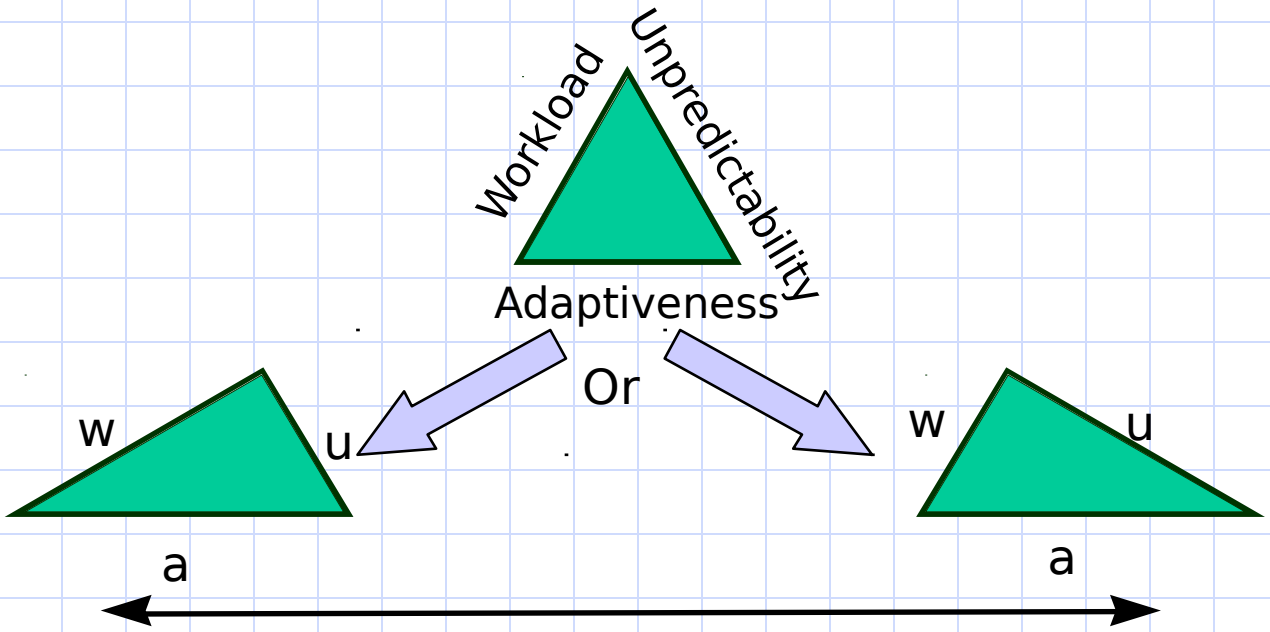


- Perceived accuracy of LED Task displays was very high
- Comments (and other ratings) indicated these were very useful to pilots

Lessons Learned

- Associates':
  - Don't have to be perfect
  - Do have to communicate
    - They must share a model of the 'situation'
  - Do have to be subordinate
    - Be able to take instruction
    - Be able to act intelligently on it
    - Be able to avoid making the same mistake over and over again
  - Should be predictable
- Don't try to wrest control from a trained, skilled operator!!
- Strong and Silent' automation is a bad idea

Controllable Automation?



Increased human management role yields increased human workload

Increased automation management role yields increased unpredictability to human

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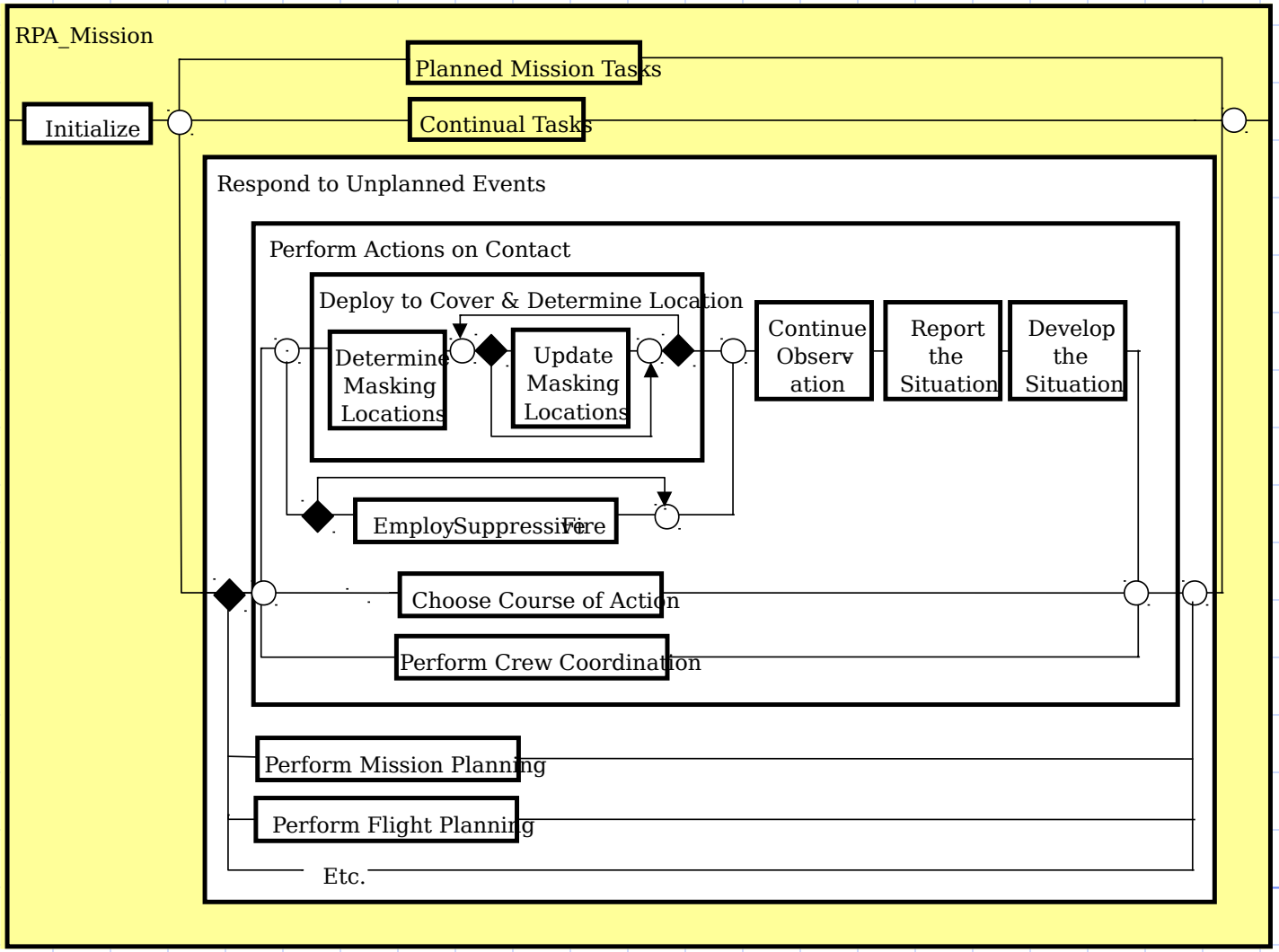
A Sample Task Model



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Q: How can we make adaptive automation systems which leave the human in charge even when s/he can't be fully in control?

A1: ~~By making them 'better'– more accurate in guessing what the human needs~~

A2: Define better, more acceptable roles and relationships which the human can control (and rely on)
and which the associate can deliver.

(enable collaboration)?

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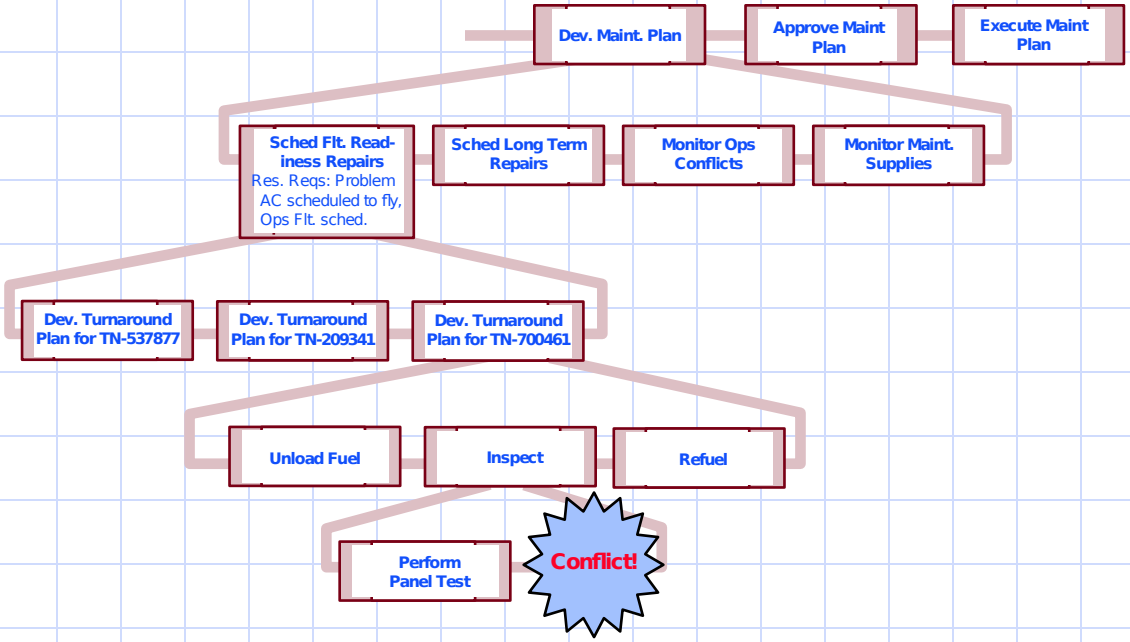
Constructive Planning



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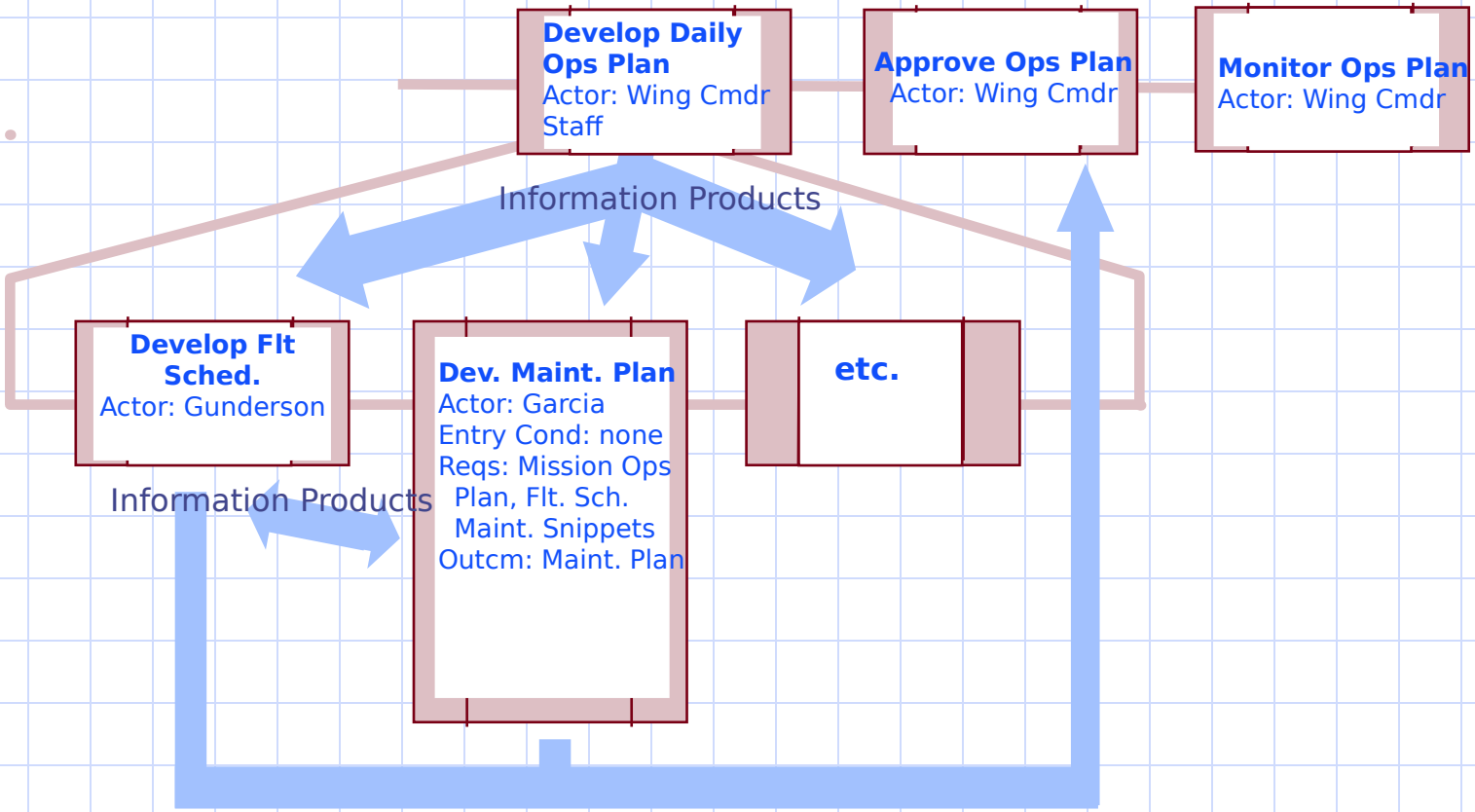
Example Snippet



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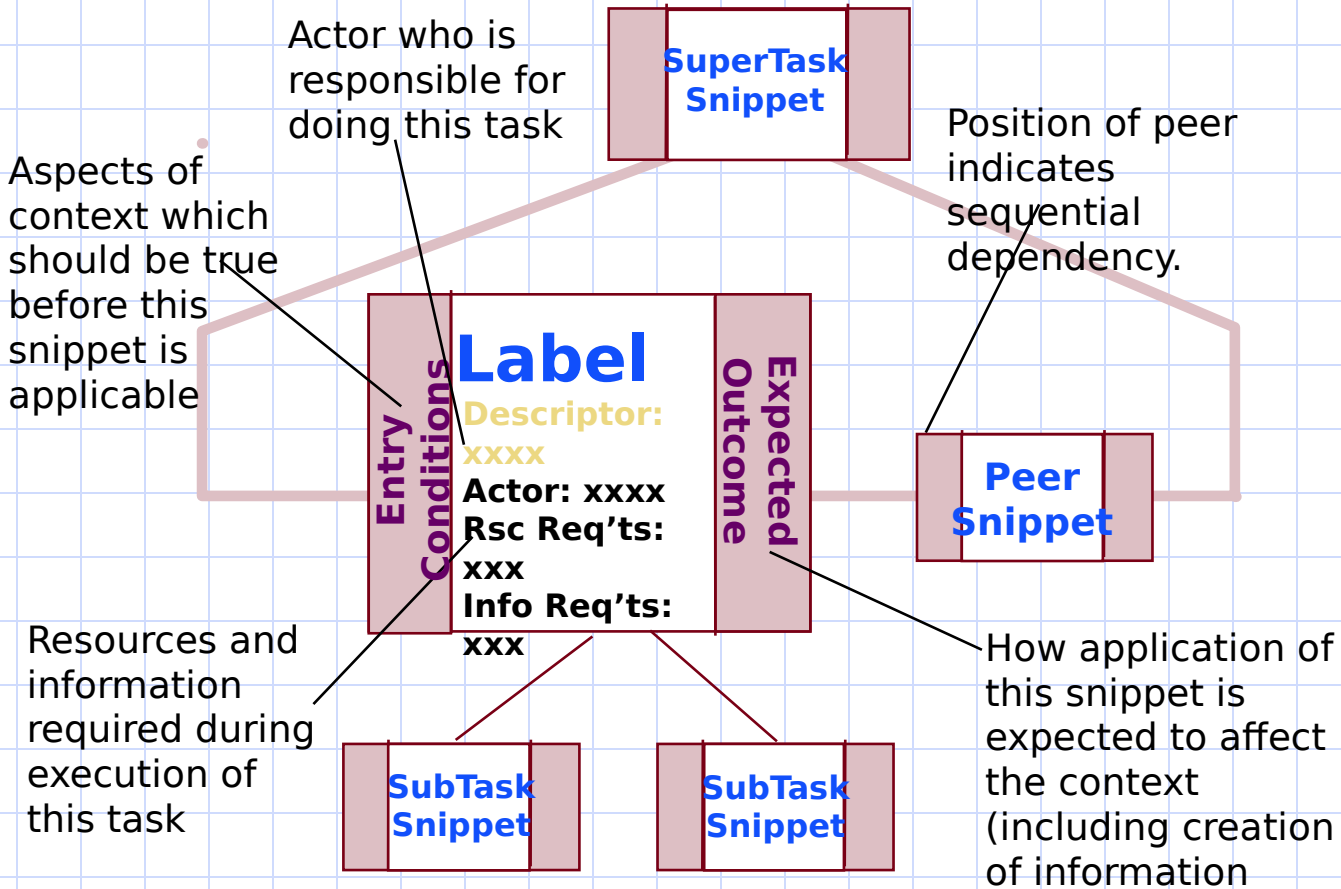
Task Snippets


Actor who is responsible for doing this task
SuperTask Snippet
Position of peer indicates sequential dependency.
Aspects of context which should be true before this snippet is applicable
Entry Conditions
Label
Descriptor: xxxx
Actor: xxxx
Rsc Req'ts: xxx
Info Req'ts: xxx
Expected Outcome
Peer Snippet
Resources and information required during execution of this task
How application of this snippet is expected to affect the context (including creation of information products)
SubTask Snippet
SubTask Snippet

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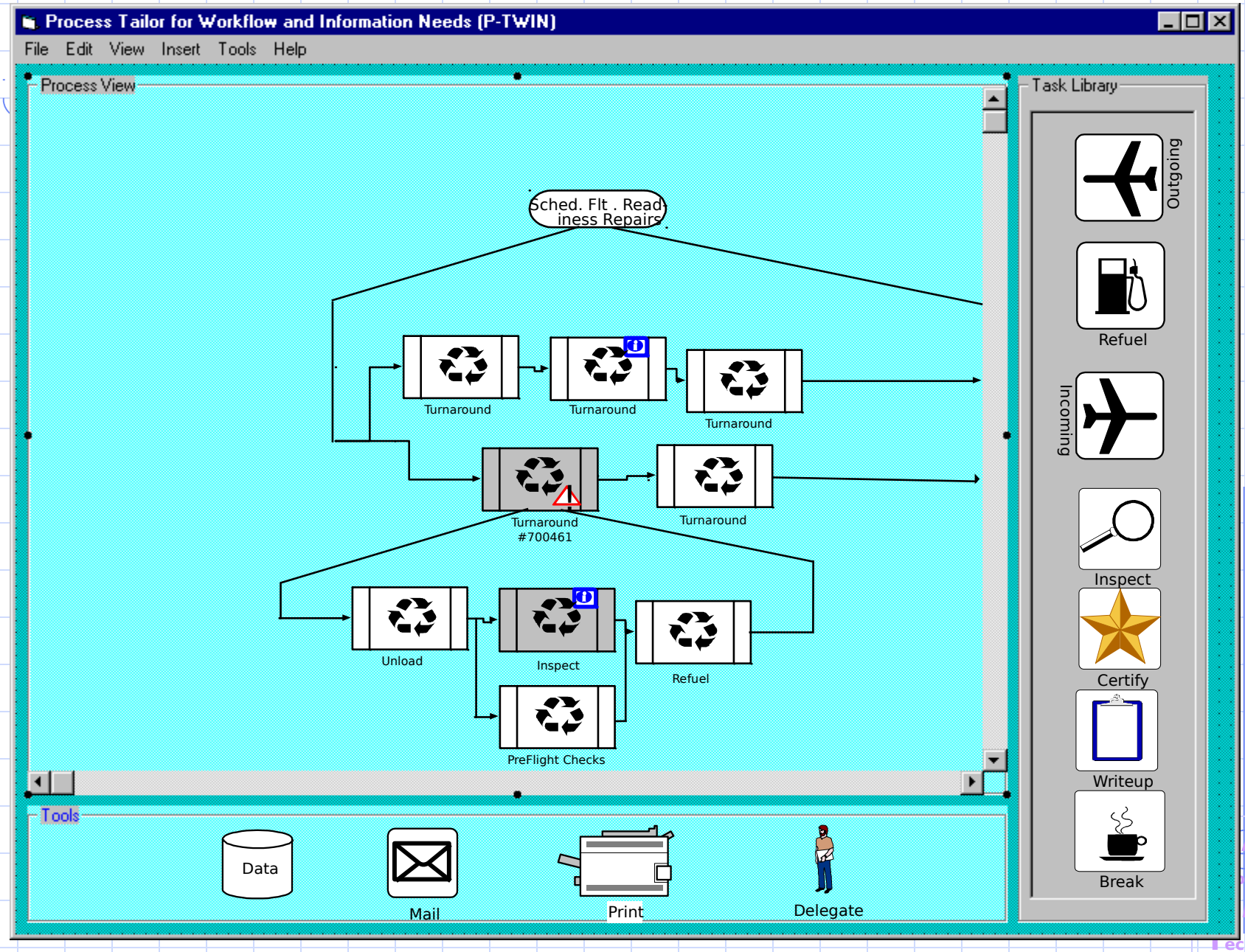
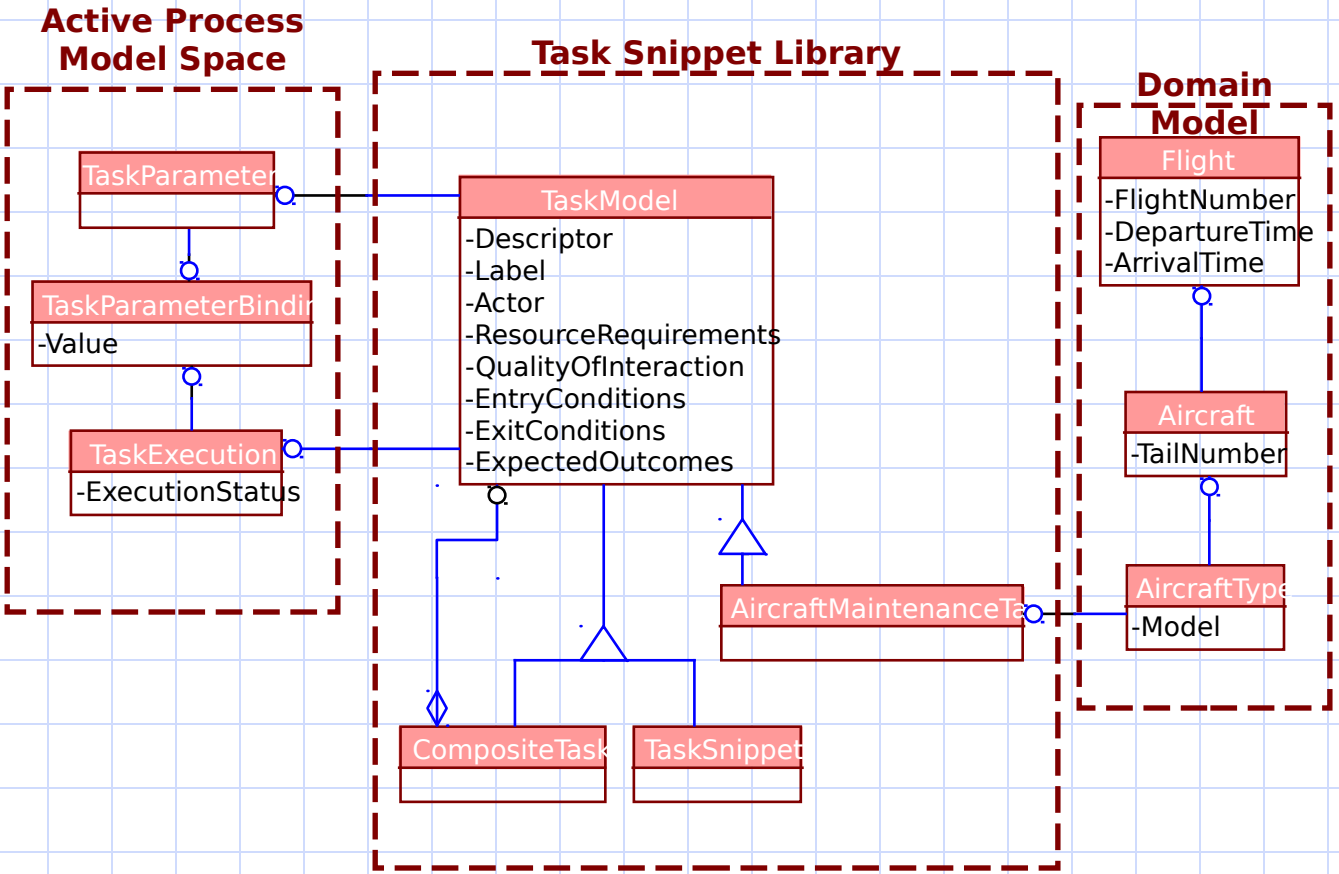
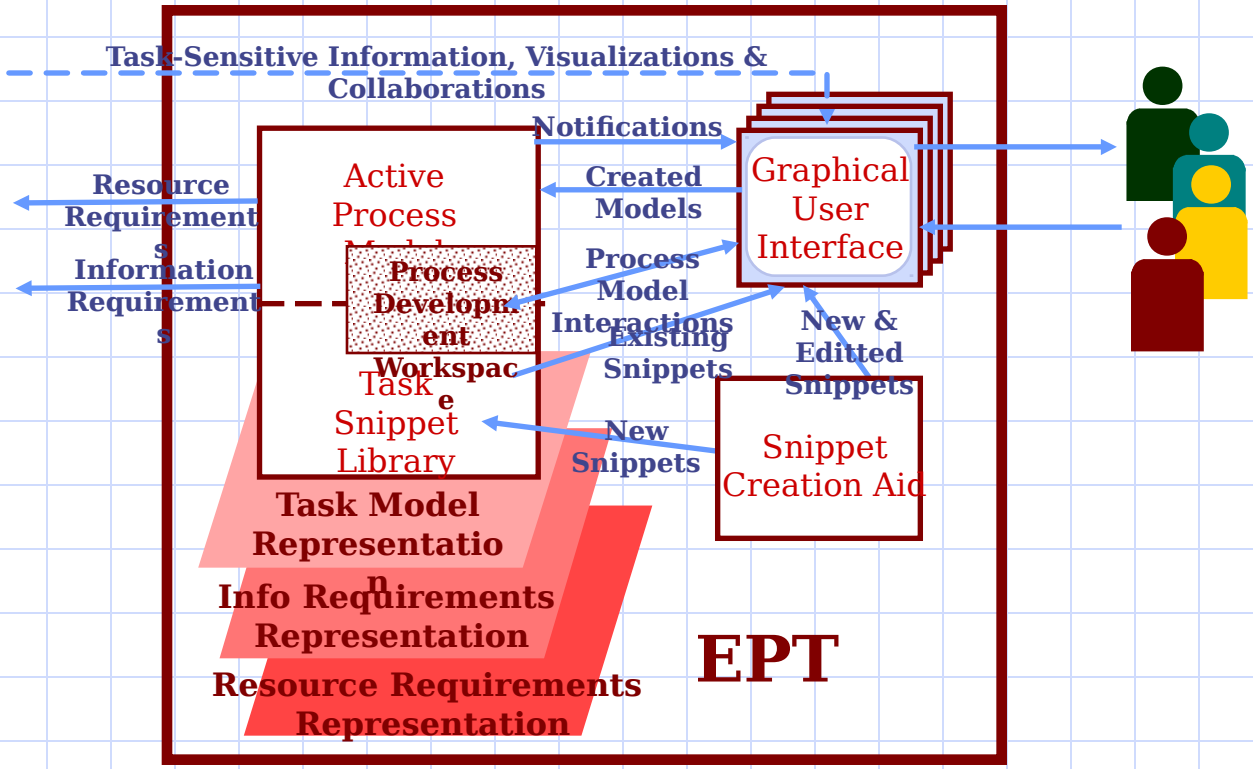

Process Tailor for Workflow and Information Needs (P-TWIN)
File Edit View Insert Tools Help
Process View
Sched. Flt . Read
iness Repairs
Turnaround
Turnaround
Turnaround
Turnaround
#700461
Turnaround
Unload
Inspect
Refuel
PreFlight Checks
Task Library
Outgoing
Refuel
Incoming
Inspect
Certify
Writeup
Break
Tools
Data
Mail
Print
Delegate

Environment for Process Tailoring (EPT)



EPT: Conceptual View



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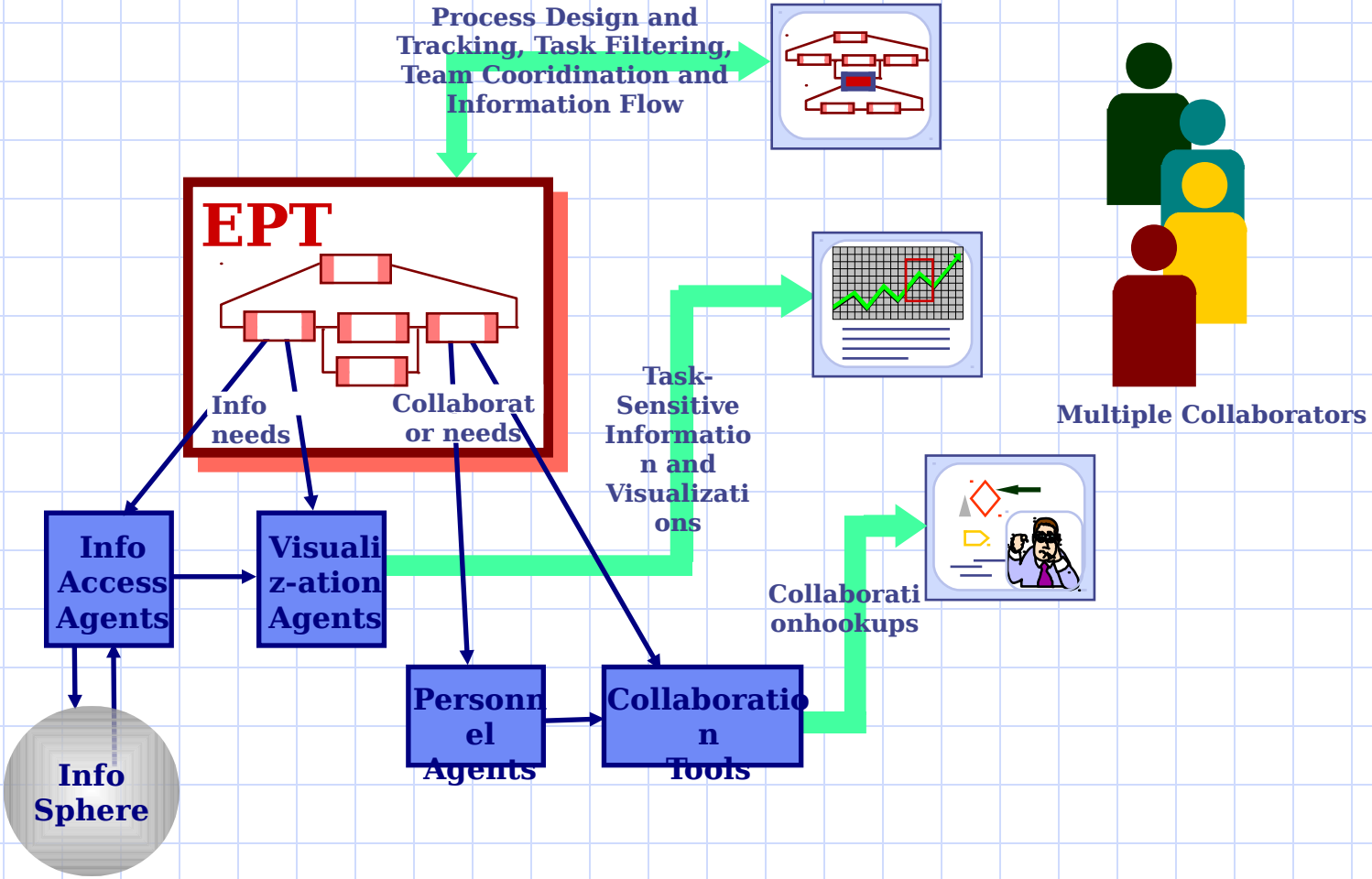
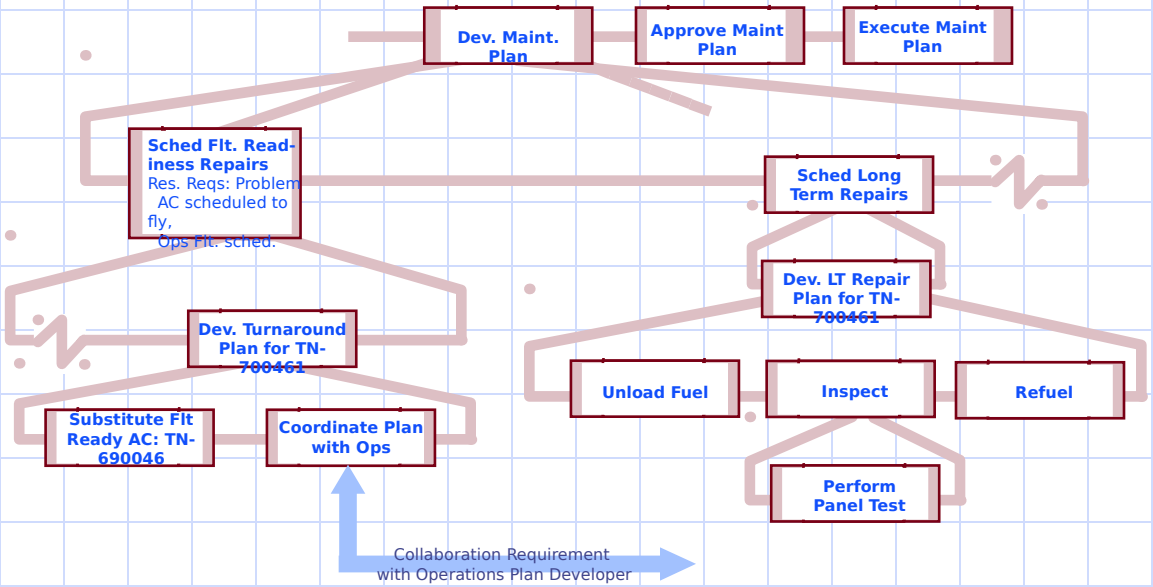
Process Tailoring



Mediated Collaboration



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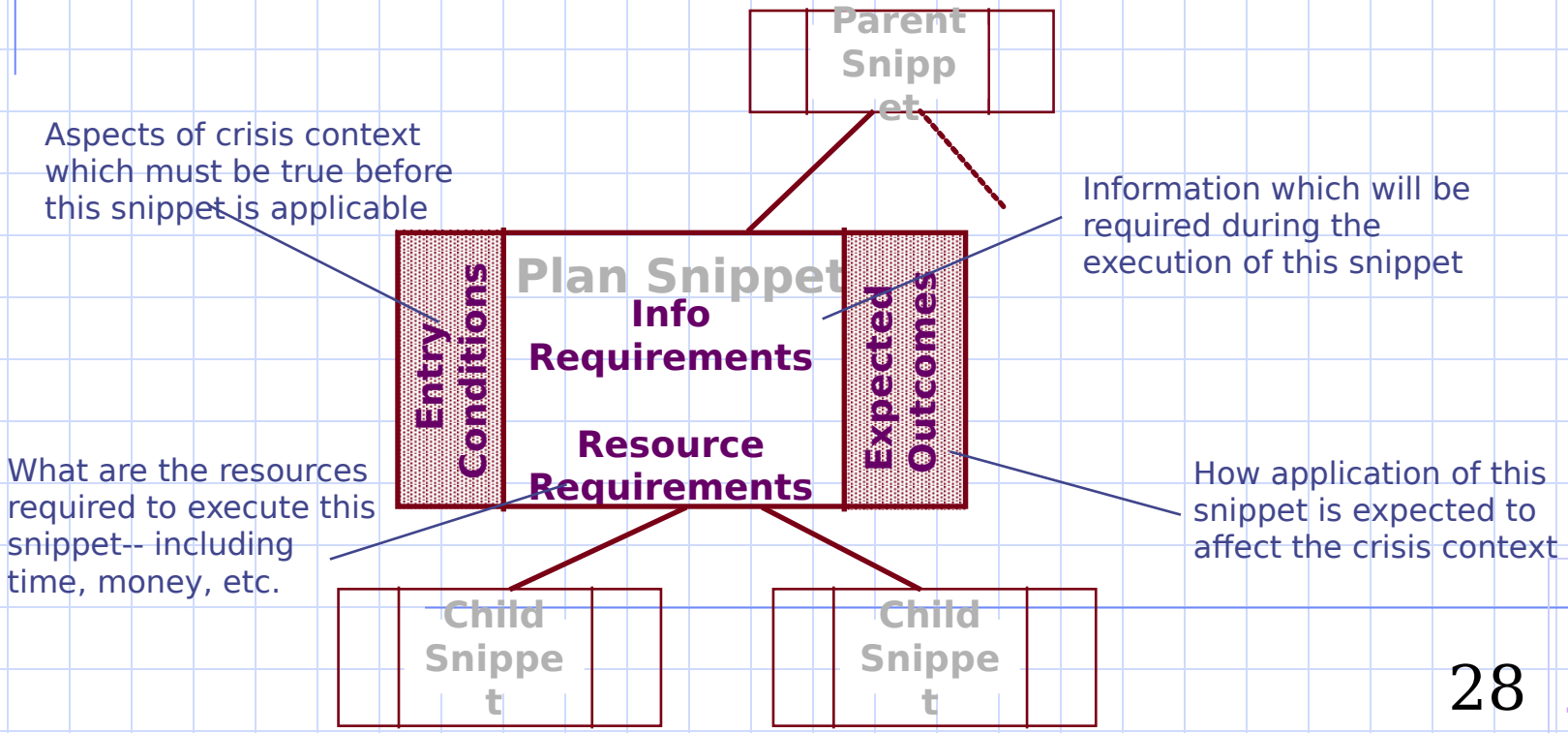
Example: Crisis Response Planning

- Create a hierarchically organized set of “plan snippets”:
- Via a graphical interface, crisis analysts will assemble snippets to create Crisis Response Plans including:
  - information gathering plans recommended COAs


Parent Snippet
Aspects of crisis context which must be true before this snippet is applicable
Information which will be required during the execution of this snippet
Entry Conditions
Plan Snippet
Info Requirements
Resource Requirements
Expected Outcomes
What are the resources required to execute this snippet-- including time, money, etc.
How application of this snippet is expected to affect the crisis context
Child Snippet
Child Snippet

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Conclusions

- Collaboration requires shared view of goals/intent
  - Intent tracking is difficult to do perfectly
    - Build the system to recover from intent estimation errors
      - or better –
    - Don't depend on intent estimation.
  - Intent declaration is natural in some domains
- Declared intent provides guidance to associates
- Intent declaration language provides content of context
- Intent that is human asserted and comprehensible to an automated associate is (probably) comprehensible to a human associate.